U.S. DEPARTMENT OF ENERGY
NUCLEAR ENERGY RESEARCH INITIATIVE
ABSTRACT

PI: **Jose N. Reyes, Jr.** **Proposal No.: 01-094**

Institution: **Oregon State University**

Title: **Testing of Passive Safety System Performance for Higher Power Advanced Reactors**

The objective of this project is to assess the performance of various passive safety systems for advanced reactors operating at powers on the order of 3000 MW thermal. The advantage of passive safety systems for core cooling following loss-of-coolant accidents is that they do not rely on safety grade pumps or AC power. They rely on natural driving forces such as gravity, compressed gas, and natural circulation to provide core cooling for an indefinite period of time after an accident. Currently, the AP600 is the only passively safe nuclear plant in the world that has received Design Certification from the USNRC. Westinghouse has recently proposed the development of an AP1000 that would offer significant economic advantages over the AP600. Because of its multiple passive safety systems, the availability of a geometrically similar integral test facility at OSU, and the lower power AP600 database which can be used for purposes of comparison, the higher power AP1000 would be an ideal candidate for this passive safety system study.

The proposed work would be carried out over a three-year period, *the third year being optional*, with the focus of each year as follows:

- Year 1: Test facility scaling analysis and facility modifications.
- Year 2: Passive safety system assessment for Loss-of-Coolant-Accidents (LOCAs).
- Optional Year3: Passive safety system assessment for beyond design basis accidents.

Westinghouse will provide OSU with a detailed description of the AP1000 design during the first year. This data will be used to perform a scaling analysis for the AP1000 to determine what modifications are required to properly model AP1000 passive safety system behavior in the existing reduced scale APEX test facility. The modifications will be completed in the first year. Testing will begin in the second year. All of the design basis accident testing would be completed during the second year.

The second year will focus on an assessment of the Passive Residual Heat Removal (PRHR) heat exchanger, the accumulators, the Automatic Depressurization Systems, (ADS) and the Core Make-up Tanks (CMTs) under LOCA conditions at high decay powers. The third year will focus on an assessment of the passive safety systems under very limiting conditions. Some of these tests, for example ADS 4 blowdowns, can be performed at full pressure conditions. In addition, new passive safety systems will also be examined during the third year. Possible candidates for this testing phase might include an accumulator vortex flow limiting device and an ADS reactor vessel head vent.

Analyses and calculations will be performed to assess the capabilities of thermal hydraulic codes to predict passive safety system behavior at high decay powers. In addition, test facility arrangement drawings will be prepared as an essential part of this effort. The project will be completed with a report summarizing the work performed and the major findings. The total cost for a two-year effort would be $1,347,030. If the third year option, “Beyond design basis Accidents,” were accepted, the total cost for the three-year program would be $1,842,641.